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EXAMINER	
WONG, LINDA	
ART UNIT	PAPER NUMBER
2611	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

us-docketing@qualcomm.com

Office Action Summary	Application No.	Applicant(s)
	10/821,390	WALLACE ET AL.
	Examiner	Art Unit
	LINDA WONG	2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 October 2010*.
2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-55* is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) *1-55* is/are rejected.
7)☐ Claim(s) _____ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a)☐ All b)☐ Some * c)☐ None of:
1.☐ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Response to Arguments

1. Applicant's arguments filed 10/21/2010 have been fully considered but they are not persuasive.

   a. Regarding the 35 USC 101 rejection, the applicant has amended the claims 1,21 to includes an apparatus within a mathematically claims invention. The rejection still stands due to the additional limitation, "transmitting at least one transmit symbol based on the at least one steering matrix", is an extra solution activity outside of the essential or significant element of the claimed invention. In other words, the significant or essential element of the invention has not been tied to an apparatus. Thus, the method is ineligible. The rejection has been updated in light of the new limitation.

   b. Regarding claims 1,13,17,21,34,39,42,47,50, 53-55, the applicant contends

> "Respectfully, Applicants submit that the Examiner has not properly characterized the teachings of the references and/or the claims at issue. Accordingly, a prima facie case of obviousness has not been established.
>
> For example, the Examiner concedes that *Kishigami* "does not clearly show selecting at least different scalar values," but relies on *Adams* as teaching this element (page 5 of the current Office Action). Despite the Examiner's contentions, however, *Kishigami* in view *of Adams* does not teach, show, or suggest "selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value" and "forming at least one steering matrix by multiplying a base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars" as recited in claim 1.
>
> In the current Office Action, the Examiner refers to Equation 12 of *Kishigami* and corresponding description as teaching "selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, and each scalar being a real or complex value" (page 4). The Examiner refers to element a(0) in Equation 12 as a "scalar vector" and states that col. 4, lines 50-51 discloses that "the scalar vector contains scalar values selected for a specific array antenna." *Id.* However, col. 4, lines 50-51 only teach that "[[x[[is the norm of vector x, and a(θ) is a normalized steering vector of the array antenna." Applicants respectfully submit that the Examiner has made up the term "scalar vector" and that there is no such teaching in *Kishigami*. *Kishigami* teaches only that "a(θ) is a complex response (hereinafter called a steering vector) of the array antenna as a function of azimuth θ" (col. 2 lines 6-8). Therefore, *Kisihigami* is silent with respect to "selecting at least

> one different combination of scalars" as recited in claim 1. In fact, the only "selecting" described in *Kishigami* is with reference to selecting complex digital signals or selecting antennas. Independent claims 13, 17, and 53 recite similar limitations not taught by the art of record.
>
> As another example, Equation 12 *of Kishigami* does not teach "each combination including at least one scalar for at least one row of the base matrix, *one scalar per row"* as recited in claim 1 (emphasis added). Equation 12 teaches that a unitary matrix QM may be multiplied with a steering vector a(0) to produce real vector b(0). Applicants respectfully submit that with matrix multiplication (including multiplying a matrix with a vector), there cannot possibly be one scalar per row as required by claim 1. According to matrix multiplication, the element ij of the matrix product of matrices [A] and [B] will be the dot product of row i of [A] and column j of [B]. For example, if row i of [A] is [1 2 3 4] in a 4 x 4 matrix and columnj of [B] is [a b c d], then element ij of [A][B] is equal to (1)(a) + (2)(b) + (3)(c) + (4)(d). The Examiner's attention is directed to any textbook on matrix multiplication and/or "Matrix Multiplication," http://en.wikipedia.org/wiki/Matrixmu#iplication, March 31, 2010. Therefore, rather than "one scalar per row" of the base matrix as required by claim 1, Equation 12 of Kishigami teaches more than one scalar per row of unitary matrix QM since a((t) has M elements, and M> 1 (col. 4 lines 1- 51). In the case of a 4-element vector a(θ) multiplied with a 4 x 4 matrix QM, for example, this would involve 4 scalars per row of the matrix, rather than one scalar per row of the matrix as required by claim 1. Independent claims 13, 17, and 53 recite similar limitations not taught by the art of record."

The examiner respectfully disagrees. In the applicant's argument, the focus of the above paragraph in the applicant's argument is the term scalar. The claim fails to recite an exact definition of the term. Based on the broadest interpretation of the claim within the scope of the invention, the term "scalar" is interpreted as a parameter value for some portion of the antenna communication system. Col. 4, lines 50-51 defines a(θ) as a "steering vector". Col. 2, lines 1-50 explains the azimuth θ and its association with the communication system. Col. 13, line 60-Col. 14, line 20 discloses the steering vector is an array of values for the arrival angle of each antenna element. Since the steering vector consists of values or parameter values that depict the arrival angle of the each antenna element, the steering vector and its values can be interpreted as the combination of scalar values. For a simpler example and definition of steering vectors, please see document antenna-theory.com,

steering vector. **Note**: The document from antenna-theory.com is not used as a reference for purposes of a rejection but simply to provide a reference to simply explain steering vectors.

The applicant further contends

"The Examiner's attention is directed to paragraphs [0024] and [0025] of the present application for an example of "selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row" and then multiplying a single selected scalar per row of the base matrix to form the steering matrix. For example, "for an NxN base matrix, each of rows 2 through N of the base matrix may be independently multiplied with one of K different possible scalars" (paragraph [0026] lines 1-2, emphasis added).

Furthermore, Applicants respectfully submit that a person having ordinary skill in the art would not consider a vector as a "combination of scalars" as recited in independent claims 1, 13, 17, 21, 34, 39, 42, 47, 50, and 53-55. A vector can be defined as "a one-dimensional array" (American Heritage Dictionary, 2nd College Edition. Boston: Houghton Mifflin Company, 1991). In contrast, a combination of scalars is not an array, but is simply a set of real or complex values (paragraph [0034] of the present application). For example, the combination of scalars may include "any one of K possible scalars" where "K may be four, and the four possible scalars may be +1, -1, +j, and - j." Id. Therefore, steering vector a(θ) does not teach a combination of scalars."

The examiner respectfully disagrees. The applicant contends the steering vector as disclosed by Kishigami cannot be considered a "combination of scalars", wherein a "combination of scalars" is a set of real or complex values. The examiner would like to point out the values of the combination of scalars and the size of the "combination of scalars" is not recited. The stipulations recited in the claim to define a "combination of scalars" would be "at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being real or complex value". Furthermore, the limitation recites "at least one different combination of scalars", wherein the phrase "at least one" is

interpreted as 1 or more. Equation 33 of Kishigami et al shows steering vector elements or values, wherein at least one or one set of combination of elements or value or scalars are shown. The vector is shown to have "one scalar per row". The elements shown have the form of $e^{(-j2\pi*(M-1)*\sin\theta/\lambda)}$, wherein depending on the value of variables, the elements would be either real or complex values. Equation 12 of Kishigami et al multiplies the steering vector with the unitary matrix. In laws of multiplication with matrix, the column of the vector is combined (multiplication and addition) with at least one row of the unitary matrix or base matrix.

The applicant also contends

"Adams fails to overcome the deficiencies in Kishigami. Rather, Adams teaches only that the "desired beam pattern $F(\varphi)$ of the antenna array may be selected for M values of φ " where the "desired steered beam pattern $F(\varphi_m)$, i.e., the desired electric field of the antenna array at azimuth m, has a dimension of 1 x M" (col. 3 lines 33-38). In other words, *Adams* teaches selecting a vector having a dimension of 1 x M, not a combination of scalars. Furthermore, as described above with respect to *Kishigami,* such a vector in *Adams* could not possibly involve "at least one scalar for at least one row of the base matrix, *one scalar per row"* as recited in claim 1."

The examiner respectfully disagrees. Adams discloses selecting a vector, which consists of scalars or steering values that dictate the electric filed of the antenna array. By selecting the vector, one would select the respective elements of the selected vector. As indicated in the office action, it would be obvious to one skilled in the art to perform selection of the vector, which would select the elements within the vector as disclosed by Adams into the computation of the steering vector of Kishigami et al so to provide a desired

steered beam patter, which contributes to effective determination of the angle of arrival shown in Equation 4 of Kishigami et al.

c. Regarding the dependent claims, such claims are depend on respective independent claims. Please see the rebuttal of the independent claim.

d. Based on the rebuttal above, the previous rejection stands as stated. A copy is provided below.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

2. **Claims 1-12,21-33,42-46,50-52** is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

a. **Claim 1** pertains to mathematical steps of "generating steering matrices" and is directed to a judicial exception to 35 U.S.C. 101 (i.e., an abstract idea, natural phenomenon, or law of nature) and is not directed to a practical application of such judicial exception (e.g., because the claim does not require any physical transformation and the invention as claimed does not produce a useful, concrete, and tangible result). The new limitation, “transmitting at least one transmit symbol based on the at least one steering matrix”, does not place the method in eligible subject matter due to the limitation is an extra solution activity using the significant subject matter as opposed to indicating an apparatus for producing or using the significant subject matter. The significant subject matter

is the computation of the steering matrices performed by the step of selecting at least one different combination of scalars and forming at least one steering matrix by multiplying the based matrix and at least one different combination of scalar. The examiner suggests including in the body of the claim an apparatus for the significant steps such as "a processor is used to select at least one different combination of scalars ...."

b. **Claims 21,42,50** recites the steps and components of “generating steering matrices”, wherein paragraph 75 states the steps and components can be performed in software. Software is directed towards a judicial exception to 35 USC 101 (i.e., an abstract idea, natural phenomenon, or law of nature) and is not directed to a practical application of such judicial exception (e.g., because the claim does not require any physical transformation and the invention as claimed does not produce a useful, concrete, and tangible result).

c. **Claims 2-12,22-33,43-46,51-52** are rejected as per the respective independent claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. **Claims 1-3,5-21,24-26,29-41,53-55** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Adams (US Patent No.: 6218985).

   a. **Claims 1,17**,

      i. Kishigami et al discloses

         - "obtaining a base matrix" (Equation 12, label Qm as the base matrix)
         - "at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value" (Equation 12, label a(θ) as the scalar vector, wherein the scalar vector contains scalar values selected for a specific array antenna. (Col. 4, lines 50-51 discloses a(θ) is produced for the array antenna. Col. 14, line 15, equation 33 shows the elements in a(θ), wherein the values can be real or complex depending on θ. Based on the laws of multiplying matrices', the scalar vector as shown in Eq. 33 as a column, would be multiplied with each row of the matrix, Qm.) and
         - "forming at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars". (Equation 12 in Col. 6, line 26 discloses multiplying the base matrix, Qm, with steering vector or scalar a(θ), wherein b(θ) is a modified steering vector. Col. 19,

lines 9-15 discloses the Qm and a(θ) is a unitary transform of R, the correlation matrix or steering matrix.)

- “transmitting at least one transmit symbol based on the at least one steering matrix" (Fig. 18 shows the transmitting unit, where transmit signals with at least one transmit symbol will be transmitted according to the arrival direction estimation. Such estimation is determined using the steering matrix of equation 12.)

ii. Kishigami et al does not clearly show selecting at least different scalar values.

iii. Adams discloses in Col. 3, line14-40 discloses an active sector of the antenna array, wherein the active sector is antenna elements of the antenna array being driven. The beam pattern of the antenna array is determined by selecting M values of the azimuth angle. Kishigami et al discloses equation 33 as the steering vector for the antenna array shown in Fig. 1, wherein the steering vector values dependents on the azimuth angle. It would have been obvious to one skilled in the art to select the azimuth angle according to selecting M values to produce a beam pattern of the antenna array as disclosed by Adams in the calculation of the steering vector as disclosed by Kishigami et al so to produce the desired steered beam pattern, which contributes to effectively determining the angle of arrival as shown in Equation 4 of Kishigami et al. (The steering vector affects the calculation of the angle of arrival (F(θ))).

b. **Claim 2**, Kishigami et al discloses “forming a plurality of steering vectors with columns of the at least one steering matrix”. (Equation 12 discloses a modified steering matrix using $a(\theta)$, wherein $a(\theta)$ can be computed for multiple θ.)

c. **Claim 3**, Kishigami et al discloses "the base matrix is a unitary matrix having orthogonal columns." (Col. 6, line 25 discloses the base matrix is a unitary matrix. Such a matrix is used to compute the steering vector $b(\theta)$, which can be used to produce R matrix. (Fig. 10 shows the correlation matrix R transformed in to a unitary equivalent using Qm, $a(\theta)$.) R matrix is the correlation matrix containing eigenvectors, such vectors are orthogonal, thus Qm would have orthogonal elements.)

d. **Claims 5,14,18,27,37**, Kishigami et al discloses the base matrix is a unitary matrix, wherein Walsh matrix is a type of unitary matrix. (Col. 6, line 25 discloses the base matrix is a unitary matrix.)

e. **Claims 6,15,19,29,** Kishigami et al discloses “each of the at least one steering matrix has orthogonal columns”. (Equation 12 shows the equation for producing the unitary transform of matrix R, wherein matrix R is orthogonal, thus would have orthogonal columns. (Col. 19, lines 9-15 discloses the Qm and $a(\theta)$ is a unitary transform of R, the correlation matrix or steering matrix. Col. 1, lines 44-67 discloses R is orthogonal.)

f. **Claims 7,8,16,20,30,38**, Kishigami et al discloses the steering vector elements, wherein the set of values would depend on the phase. (Equation 33) Although Kishigami et al fails to disclose selecting from a set of j, +j, -1, +1 as the scalar

value or steering vector values, such values would be computed given the phase of Equation 33. Adams discloses selecting the phase and amplitude of a drive signal to provide a desired beamwidth (Col. 1, lines 10-16), wherein the desired beamwidth is determined based on the phase as discussed in Col. 3, lines 34-40.

g. **Claim 9,31**, Kishigami et al discloses "each of the at least one steering matrix includes elements having equal magnitude." (Equation 12 discloses the production of the vectors of the steering matrix R, wherein depending on the calculation of b(θ), R can have elements with equal magnitude.)

h. **Claim 10**, Kishigami et al discloses "the base matrix has a dimension of N by N, where N is an integer greater than one, and wherein each combination includes N - 1 scalars for N - 1 rows of the base matrix". (Col. 1, lines 44-45 disclose the correlation matrix is a MxM matrix. Line 25 indicates M > 1. Since the base matrix is used to produce a unitary transformation of the correlation matrix, the base matrix would also have the same dimension as the correlation matrix. Equation 12 shows scalar multiplied with the base matrix, wherein the number of scalars and rows would depend on the number of elements in a row of the matrix and scalar vector.)

i. **Claim 11**, Kishigami et al discloses a correlation matrix R, is a MxM matrix, wherein R is used to produce the modified steering vector (Eqn. 12). The size of the matrix depends on the number of antennas as shown in Fig. 18 (Col. 4, lines 5-10) and can be "a power of two". It would be obvious to one skilled in the

art for N to be a power of two depends on the number of antennas as well as the inventors design choice.

j. **Claim 12**, Kishigami et al discloses “the at least one combination of scalars is obtained with a base-K counter having one digit for each of the at least one scalar in a combination, where K is the number of different possible scalars usable for each row of the base matrix”. (Col. 13, lines 15-20 discloses k is used to determine the k-th element.) Although Kishigami et al fails to disclose "a base-K counter", a base-K counter is found in software or hardware in order to keep track of the element being used so to not run past the total number of elements. It would have been obvious to one skilled in the art at the time of the invention to use a base-K counter so to keep track of the number of elements in the vector and prevent an out of bound error.

k. **Claim 13** inherits all the limitations of claim 1, but claim 1 fails to recite the limitation "a memory operative to store the base matrix, or at least one steering matrix, or both the base matrix and the at least one steering matrix". Kishigami et al discloses a processor (Col. 1, lines 30-32), wherein memory is common in a processor. It would have been obvious to one skilled in the art at the time of the invention to incorporate a memory block to store the base matrix and/or steering matrix within the processor as disclosed by Kishigami et al so to allow for easy access to the information.

l. **Claim 21** inherits all the limitations of claim 1, but claim 1 fails to recite “processing data to obtain a block of data symbols to be transmitted in a

plurality of transmission spans" and "performing spatial processing on at least one data symbol to be transmitted in each transmission span with the steering matrix obtained for the transmission span, the spatial processing resulting in the block of data symbols observing a plurality of effective channels formed with the plurality of steering matrices." (Fig. 18, labels 89-1-89-L shows the plurality of transmission, label 71 determines the block of data symbols to be transmitted. Col. 6, lines 11-16 disclose the correlation matrix is used for spatial smoothing. Fig. 18, label 63 determines the arrival direction using equation 12 and correlation matrix R, wherein the spatial processing or smoothing involves observing the channel. Regarding the limitation, plurality of transmission spans, Col. 1, lines 20-25 discloses the accuracy of a plurality of incident waves are estimated. Each incident wave would arrive at a different angle, wherein time would also be different.)

m. **Claim 24**, Kishigami et al discloses “the plurality of transmission spans correspond to a plurality of time intervals.” (Col. 1, lines 20-25 discloses the accuracy of a plurality of incident waves are estimated. Each incident wave would arrive at a different angle, wherein time would also be different.)

n. **Claims 25,35,40**, Kishigami et al discloses “each steering matrix has one column, and wherein one data symbol is transmitted in each transmission span.” (Fig. 18, labels 89-1-89-L shows the multiple antennas for receiving information at a transmission span. Col. 1, lines 45 shows the equation for correlation matrix R, wherein R can have 1 column.)

o. **Claims 26,36,41**, Kishigami et al discloses “each steering matrix has multiple columns, and wherein multiple data symbols are transmitted simultaneously in each transmission span”. (Fig. 18, labels 89-1-89-L shows the multiple antennas for receiving information at a transmission span. Col. 1, lines 45 shows the equation for correlation matrix R, wherein R can have more than 1 column.)

p. **Claims 32,33**, Kishigami et al discloses “the plurality of steering matrices’ are unknown to a receiving entity for the block of data symbols" and “known only to the transmitting entity." (Fig. 18 shows a transmitter, wherein the transmitter does not have a connection to a connecting receiver for sending the steering matrices' used to produce the data transmitted. Thus, the receiving entity would receive the data without knowing the steering matrices' used.)

q. **Claims 34,39** inherit all the limitations of claim 21.

r. **Claim 53** recites all the limitations of claim 1 but claim 1 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 1. A processor can have instructions or software for controlling the steps as discussed in claim 1. It would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) in view of Adams so to easily calculate complex equations and provide an accurate calculation.

s. **Claim 54** recites all the limitations of claim 21 but claim 21 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 21. A processor can have instructions or software for controlling the steps as discussed in claim 21. It would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) in view of Adams so to easily calculate complex equations and provide an accurate calculation.

t. **Claim 55** recites all the limitations of claim42 but claim 42 fails to recite the limitation “code for”. Kishigami et al discloses a processor (Col. 1, lines 30-32) for calculating the process as shown in Fig. 10 and as described in claim 42. A processor can have instructions or software for controlling the steps as discussed in claim 42. It would have been one skilled in the art at the time of the invention and based on the inventor's design choice to perform steering matrix calculations as discussed in Kishigami et al (explanation in claim 1) in view of Adams so to easily calculate complex equations and provide an accurate calculation.

4. **Claims 4,28** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Adams as applied to claim 1 in view of Craw (NPL: “The Fourier Matrix”).

a. **Claim 4,28**, Kishigami et al fails to disclose "the base matrix is a Fourier matrix." Kishigami et al discloses the base matrix can be any unitary matrix (Col. 6, line 25 discloses the base matrix is a unitary matrix.), wherein Fourier matrix is a type of unitary matrix. (See reference The Fourier Matrix.) Thus, it would have been obvious to one skilled in the art to use a Fourier matrix, since the base matrix must be any unitary matrix.

5. **Claims 22-23** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Adams as applied to claim 21 in view of Khatri (US Patent No.: 7020490).

   a. **Claim 22,**

      i. Kishigami et al fails to disclose "the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands."

      ii. Khatri discloses such limitations. (Col. 4, lines 53-56) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams so to provide independent phase and amplitude to avoid co-channel interference.

   b. **Claim 23,**

      i. Kishigami et al fails to disclose “multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein

each of the plurality of transmission spans corresponds to one or more subbands in one time interval."

ii. Khatri discloses such limitations. (Col. 4, lines 53-56 discloses sending information using different sub-bands and different carrier frequencies, wherein such sub-bands and carrier frequencies can be more than 1.) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams so to provide independent phase and amplitude to avoid co-channel interference.

6. **Claims 42,45-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kishigami et al (US Patent No.: 6642888) in view of Adams (US Patent No.: 6218985), further in view of Khayrallah et al (US Patent No.: 6711124).

a. **Claim 42** inherits all the limitations of claim 1 or 21, but claim 1 fails to recite the limitations "deriving a plurality of spatial filter matrices based on a channel response estimate and a plurality of steering matrices", "obtaining, in the plurality of transmission spans, R sequences of received symbols via R receive antennas, where R is an integer one or greater" and "performing receiver spatial processing on the R sequences of received symbols with the plurality of spatial filter matrices to obtain detected symbols".

b. Kishigami et al fails to disclose such limitations.

c. Khayrallah et al discloses in Fig. 6 a receiver uses the channel estimate for equalization, wherein the channel estimates are produced based on the training sequences. (Col. 1, lines 29-42) The training sequences are produced using the scaling matrix as shown in Fig. 3. Fig. 4 shows a plurality of antennas, wherein the plurality of antennas would receive one or more sequences since each antenna would receive information. It would have been obvious to one skilled in the art at the time of the invention to incorporate the use of a channel equalizer as disclosed by Khayrallah et al into Kishigami et al in view of Adams so to eliminate interference within the signal after transmission by filter or equalizing.

d. **Claims 45 and 46**, Khayrallah et al discloses "each steering matrix has one column, and wherein each spatial filter matrix has a dimension of one by one" and "each steering matrix has N columns and each spatial filter matrix has a dimension of N by R, where N and R are integers greater than 2. (Fig. 6 shows the receiver performing channel estimation and equalization. Fig. 7 shows the calculation of the channel estimation. Col. 7, line 58-Col.8, line 18 discloses the channel estimates are determined based on the scaling value matrix elements from the column corresponding to the antenna. Given the scaling value matrix is one by one, then the channel estimates would be a one by one matrix. Given the scaling value matrix is N by R, wherein N and R are integers greater than 2, the channel estimate would be a N x R matrix.)

e. **Claims 47 and 50** inherits all the limitations of claim 42.

f. **Claims 48-49 and 51-52** inherits all the limitations of claims 45 and 46.

7. **Claims 43-44** are rejected under 35 U.S.C 103(a) as being unpatentable over Kishigami et al in view of Adams, further in view of Khayrallah et al as applied to claim 42 in view of Khatri (US Patent No.: 7020490).

   a. **Claim 43,**

      i. Kishigami et al, and Adams fails to disclose "the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands."

      ii. Khatri discloses such limitations. (Col. 4, lines 53-56) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams, further in view of Khayrallah so to provide independent phase and amplitude to avoid co-channel interference.

   b. **Claim 44,**

      i. Kishigami et al, and Adams fails to disclose "multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein each of the plurality of transmission spans corresponds to one or more subbands in one time interval."

      ii. Khatri discloses such limitations. (Col. 4, lines 53-56 discloses sending information using different sub-bands and different carrier frequencies,

wherein such sub-bands and carrier frequencies can be more than 1.) It would have been obvious to one skilled in the to transmit using OFDM as disclosed by Khatri, wherein transmission signals are produced using orthogonal scaling as disclosed by Kishigami et al in view of Adams, further in view of Khayrallah so to provide independent phase and amplitude to avoid co-channel interference.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LINDA WONG whose telephone number is (571)272-6044. The examiner can normally be reached on 9-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Payne can be reached on (571) 272-3024. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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